SPIXIANA	26	3	193–208	München, 01. November 2003	ISSN 0341-8391

Proceedings of the FORUM HERBULOT 2003. Geometridae of the Indo-Pacific region and Australia: Inventories, evolution, colonization, Gondwana distributions (Zoologische Staatssammlung München, 13.-14.3.2003)

Axel Hausmann (ed.)

Hausmann, A. (ed.) (2003): Proceedings of the Forum Herbulot 2003. Geometridae of the Indo-Pacific region and Australia: Inventories, evolution, colonization, Gondwana distributions (Zoologische Staatssammlung München, 13.-14.3.2003. – Spixiana **26/3**: 193-208

A short report on the results of the Forum Herbulot 2003 is presented emphasizing the great impact that this meeting had for coordinated, modern research in Geometridology and for creating a worldwide, IT-based network of scientists working on Geometridae. The abstracts of fourteen lectures from the seminary session of the Forum Herbulot are added.

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Short Report and Results

Axel Hausmann, Jeremy D. Holloway, Martin Krüger, Peter McQuillan & Manfred Sommerer

Hausmann, A., Holloway, J. D., Krüger, M., McQuillan, P. & M. Sommerer (2003): Short report and results. In Hausmann (ed.): Proceedings of the Forum Herbulot 2003; Geometridae of the Indo-Pacific region and Australia: Inventories, evolution, colonization, Gondwana distributions (Zoologische Staatssammlung München, 13.-14.3.2003. – Spixiana **26/3**: 193-195

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1. The chairman outlined once more the aims of the FORUM HERBULOT (see www.herbulot.de). The participants welcomed the research initiative and stressed the need for, and advantages of, the opportunities offered for close scientific cooperation among geometrid experts. Access to the rich Coll. Herbulot with its manifold historical assets was greatly appreciated. Following a brief address from Claude Herbulot (*in absentia* presented by Philippe Darge) the participants expressed their respect for the achievements of the founder of the collection and patron of the Forum. The use of internet-based tools with a view to linking collection data with existing or planned databases in order to improve the availability of relevant data was discussed (Henry Barlow, A. Hausmann).

Participants, guests and meeting assistants of the FORUM HERBULOT 2003: From left to right: Anthony C. **Galsworthy** (London, U.K.), Stefan **Schmidt** (ZSM, Munich, Germany), Hans **Löbel** (Sondershausen, Germany), George **Balogh** (behind; Portage, Michigan, U.S.A.), Olga **Schmidt** (Munich, Germany), Peter **McQuillan** (University of Hobarth, Tasmania), Alexander **Schintlmeister** (Dresden, Germany), Sven **Erlacher** (behind; ZSM, Munich, Germany), Marie-Thérèse **Ebode** (Clenay, France), Cathy **Young** (University of Hobarth, Tasmania), Vladimir **Mironov** (in front; ZISP, St. Petersburg, Russia), Andreas H. **Segerer** (ZSM, Munich, Germany), Jeremy D. **Holloway** (NHM, London, U.K.), Jaan **Viidalepp** (ZBI, Tartu, Estland), Philippe **Darge** (Clenay, France), Henry **Barlow** (Kuala Lumpur, Malaysia), A. Hausmann (ZSM, Munich, Germany; chairman), Evgeny **Beljaev** (behind, partially hidden; RAS, Vladivostok, Russia), Bernd **Müller** (Berlin, Germany), Martin **Baehr** (ZSM, Munich, Germany), Manfred **Sommerer** (Munich, Germany), Martin **Krüger** (TMP, Pretoria, South Africa), Janusz **Wojtusiak** (behind, partially hidden; Jagiellonian University, Kraków, Poland), Robert **Trusch** (SMNK, Karlsruhe, Germany), G. **Haszprunar** (director of the ZSM, Munich, Germany). – Not visible on the photo: Xue **Dayong** and Han **Hongxiang**, (both Cinese Acad. Sci., Beijing, China), Ulf **Buchsbaum** and Michael **Miller** (both ZSM, Munich, Germany), Stefano **Scalercio** (Univ. Cosenza, Italy), Alberto **Zilli** (Mus. civ., Rome, Italy).

2. The seminar session highlighted promising possibilities for systematic research. The first four talks (J. D. Holloway, M. Krüger, C. Young, P. McQuillan) presented and summarized the actual stage of research concerning the phylogeny of Geometridae on subfamily and tribe level as resulting from different data sets, such as larval morphology (M. Krüger, C. Young), adult morphology (J. D. Holloway, M. Krüger), host-plant relationships (J. D. Holloway, P. McQuillan), zoogeographical patterns (M. Krüger, J. D. Holloway) and molecular analysis (C. Young, P. McQuillan). The study of skeleto-muscular anatomy of genitalia as additional information was encouraged (E. Beljaev).

The southern hemisphere Archiearinae had been revised and separated from Holarctic groups (P. McQuillan). Although some morphological characters and host-plant relationships suggest that the subfamilies Archiearinae and Oenochrominae (s.str.), and the tribes Diptychini and Nacophorini (Ennominae) are phylogenetically 'old' groups (J. D. Holloway, M. Krüger), Larentiinae and Sterrhinae appear as the most basal groups using molecular methods (sequence analysis of four nuclear and mitochondrial genes; Abraham et al. 2001, C. Young, P. McQuillan, A. Hausmann, S. Erlacher). Refinement of molecular methods as valuable tools for evolutionary and systematic studies had been postulated by the Forum Herbulot 2001 (Hausmann & Trusch 2001) in order to supplement the morphological and ecological data sets. Now, on the basis of the paper by Abraham et al. (2001), promising results have been obtained by the two 'molecular' groups actually working on Geometridae (C. Young & P. McQuillan, A. Hausmann, S. Erlacher & M. Miller). After discussion of all the findings, closer coordination and cooperation was agreed upon, and working plans were established, in order to focus future common research on a better understanding of the basic phylogeny of Geometridae.

Research on Eupitheciini constituted another theme of the meeting. Extention to research on a global scale (as recommended by Forum Herbulot 2001: Hausmann & Trusch 2001) is needed to fill existing gaps in our knowledge (e.g. Eupitheciini in Africa in relation to Asia and other regions). Cooperation was improved regarding Chinese (T. Galsworthy, V. Mironov, X. Dayong), and initiated for neotropical Eupitheciini (G. Balogh, J. Wojtusiak). New agenda for cooperation dating back to Forum Herbulot 2001 concerning the exploration of neotropical Geometridae were established (G. Balogh, A. Hausmann, J. Wojtusiak).

An interesting zoogeographical analysis of Australian carabids was presented (M. Baehr) and compared with similar findings for Lepidoptera. Gondwana distributions, drift on tectonic plates and colonization were discussed with respect to some taxa from Africa, Australia, and the Indo-Pacific region (M. Krüger, J. D. Holloway, P. McQuillan). Speciation and variation of several taxonomically 'difficult' groups of Indo-Pacific Geometridae were presented for discussion (X. Dayong, O. Schmidt, M. Sommerer, J. Viidalepp).

3. A proposal to continue the FORUM HERBULOT in Hobart, Tasmania late 2005 or early 2006 (organisation: P. McQuillan) was welcomed.

4. Participants expressed their thanks to the organizers and sponsors of the FORUM HERBULOT 2003.

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Hausmann, A. & R. Trusch (eds.) 2001. Proceedings of the FORUM HERBULOT 2001. – Spixiana **24**(3): 193-202

Opening address

Philippe Darge & Claude Herbulot

presented in absentia of Claude Herbulot by Dr. Philippe Darge, president of honour of the "Union de l'Entomologie Française (U.E.F.)"

Darge, P. & C. Herbulot (2003): Opening address. In Hausmann (ed.): Proceedings of the Forum Herbulot 2003; Geometridae of the Indo-Pacific region and Australia: Inventories, evolution, colonisation, Gondwana distributions (Zoologische Staatssammlung München, 13.-14.3.2003. – Spixiana **26/3:** 195-196

Dr. Philippe Darge, 21, Grande Rue, Clenay, France

Claude Herbulot, 67, rue de la Croix Nivert, F-75015, Paris, France

Chers collègues, chers amis,

C'est avec beaucoup d'émotion que je prends la parole devant vous, avec l'étrange impression d'usurper la place qui revenait à celui qui est la raison même de ce colloque.

Cependant, la longue amitié qui m'unit à Claude Herbulot m'incite fortement à répondre à la demande qu'il m'a faite de vous délivrer, à sa place, le message préparé à votre intention, message de souvenirs et de réflexion sur la nature et la finalité de nos activités.

Claude Herbulot a 12 ans lorsque, en 1920, il fait la connaissance du docteur Niessen, consul du Danemark à Alger. Le diplomate se passionne pour les papillons dont il capture de nombreux exemplaires aux abords de sa magnifique villa fleurie sur les hauts d'Alger. Il offre à Claude un exemplaire de la belle géomètre *Crocallis auberti* Oberthür et c'est alors le véritable point de départ de la magnifique collection qu'abrite désormais ce musée.

Le jeune garçon qu'est Claude Herbulot est fasciné par ce que le docteur Niessen lui fait découvrir, notamment les multiples aspects d'une collection:

l'esthétique, qui transcende formes et couleurs des papillons, les joies de la découverte, nourries par les voyages et l'exploration de pays lointains, l'intérêt scientifique, qui plonge ses racines dans la recherche toujours plus approfondie des origines, des formes et du devenir de la Vie.

A ce devoir de souvenir et de reconnaissance qu'il exprime à l'égard du docteur Niessen, Claude Herbulot souhaite également associer quelques-uns des grands lépidoptéristes qui ont, ensuite, conforté sa vocation et l'ont entouré de leurs conseils pour développer ses recherches et bâtir, peu à peu, son exceptionnelle collection: Le Cerf, Radot, Caruel, Dardenne, Legras, Bayard, le marquis du Dresnay ...

Tous ces noms figurent sur des étiquettes de la collection Herbulot, témoignages d'un passé émouvant, précieux capital d'étude pour aujourd'hui, message d'encouragement à la recherche de demain ...

Pour illustrer ces propos, je vous présente le carton de la collection Herbulot contenant le *Crocallis auberti*: en tête de colonne vous y retrouvez les exemplaires offerts par le docteur Niessen, sans lesquels, peut-être, la vie de notre ami eût pris un autre cours.

J'espère, mes chers collègues, avoir été un bon interprète de ce que notre éminent collègue Claude Herbulot souhaitait nous faire partager. Il me semble cependant que, derrière le formalisme des mots, il est un autre message, plus profond, sur lequel nous sommes invités à méditer: nous, entomologistes, avons la chance de travailler sur une parcelle de science où se mêlent étroitement l'esthétisme, la réflexion philosophique sur le sens de toute chose, la rigueur d'observation et d'analyse du chercheur ...

Au-delà des souvenirs, et à travers une exceptionnelle collection, ne serait-ce pas ce grand message de Vie et de Pensée que notre cher ami Claude Herbulot a voulu nous transmettre aujourd'hui?

Abstracts and brief versions of some talks of the Seminar Session

The biogeography of some host-specific Indo-Australian geometrid groups in relation to the break-up of Gondwanaland: trackers or fellow-travellers?

Jeremy D. Holloway

Holloway, J. D. (2003): The biogeography of some host-specific Indo-Australian geometrid groups in relation to the break-up of Gondwanaland: trackers or fellow-travellers? – Spixiana **26/3:** 196-197

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The possibility that some Oriental groups of geometrids with relationships to Australasia were derived originally from parts of Gondwanaland that moved northwards in the Jurassic and Cretaceous is explored. Two main events could have led to this: the movement of several small terranes from adjacent to northern Australia at 165 Ma to accrete to SE Asia at 100 Ma; the movement of India from the east of Africa and Madagascar at 120 Ma to make contact with Asia at around 60 Ma.

The first episode may predate the evolution of the principal higher taxa of the Macrolepidoptera, though it is possible that the Castniidae, restricted to SE Asia, Australia and the Americas, could have been involved. The plant fossil records for the second episode, movement of India, indicate that Gondwanan groups of plants that reached.SE Asia by this means are much more likely to be of African or Madagascan affinity than Australian, though the latter is not completely excluded (Morley, 1998, 2002). Morley has suggested that the Indian drift component of the current Malesian flora may be significant. The Callidulidae, with some specialism for fern-feeding, show Oriental/Madagascan affinities.

The development and subsequent persistence of biogeographic pattern that reflects such tectonic events will be constrained by several factors. Firstly the taxa concerned must be widely distributed across the components of Gondwanaland prior to the events; this has implications concerning the geological age of the ancestral taxon. Persistence of such pattern is dependent on the extent to which it becomes confused by subsequent events, i.e. if extensive dispersal predominates over terrane fidelity.

Host specialism in herbivorous insects presents an additional constraint, in that the host plant must be present in an area before the insect can be present. The insect and host plant can be fellow-travellers on a tectonic terrane, but, in a dispersal event, the insect must track its host; it cannot precede it.

Examples of geometrid groups at a tribal level that span most of the areas of Gondwanaland include the Desmobathrini, Lithinini and Caberini. The first tribe shows some host specialism at a generic level, and there is a major section of the Lithinini restricted to fern-feeding. There is a major group of the Caberini that is restricted to the Rhamnaceae. In the Eupitheciini, the genus *Pasiphila* Meyrick is diverse in temperate Australasia, particularly New Zealand, but has a north-temperate subgenus, *Gymnodisca* Warren. Host records are diverse, but many *Gymnodisca* have been reared from Ericaceae such as *Rhododendron*, and the group may have tracked this host through the mountains of Malesia to as far east as New Guinea.

Potential examples of montane tracking from south to north by Larentiinae include a lineage of *Poecilasthena* Warren, possibly specialist on *Leptospermum* (Myrtaceae), that has reached Burma, and the genera *Tympanota* Warren and *Episteira* Warren that feed on Podocarpaceae. The ennomine genus *Milionia* Walker also feeds on Podocarpaceae with Araucariaceae. It is most diverse in New Guinea but has a number of species groups through central Malesia to mainland Asia; it is just possible that some of the more westerly groups are of Indian drift origin.

The true, robust Oenochrominae feed in Australasia on Myrtaceae and grevilleoid Proteaceae, genera with the latter habit probably forming a distinct lineage. The Oriental genus *Sarcinodes* Guenée is a member of that lineage; two species occur in Australasia but a pilot phylogenetic analysis has suggested those are sister-species nested within an Oriental clade, and that other Oriental clades are more basal, indicative of a west to east movement. All host records are from the grevilleoid genus *Helicia*, which has a similar range and, to a lesser extent, pattern of species richness to the moth genus. However, current estimates of the phylogenetic structure and range of diversification of *Helicia* indicate a more recent history, and the presence of grevilleoid Proteaceae in the Indian drift flora is uncertain.

Thus, whilst *Pasiphila*, *Milionia* and the true Oenochrominae may have contributed early Gondwanan components to the Oriental geometrid fauna, the first is not constrained by host specialism, the second requires testing through detailed phylogenetic analyses, and the third shows biogeographic incompatibility between moth and host. None currently shows any representation in or relationship to Africa or Madagascar.

Much of the subject matter of this talk has been published by Holloway & Hall (1998) and Holloway (2003).

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Out of Africa repeated? On the tribal composition of southern Ennominae and the origin of Geometridae

Martin Krüger

Krüger, M. (2003): Out of Africa repeated? On the tribal composition of southern Ennominae and the origin of Geometridae. – Spixiana **26/3:** 198

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The tribal composition of the ennomine faunas of the former Gondwanan provinces of southern Africa, Australia and the Neotropical Region, as well as of the geologically much younger island of Borneo as a surrogate for the Oriental Region, was compared. The total fauna is represented by 20 tribes and a total of 4725 species. Fifteen tribes each have been recorded from southern Africa and Borneo, 14 from Australia, and 8 from the Neotropical Region. Most tribes have a surprisingly wide distribution: the species-rich tribes Boarmiini, Baptini / Caberini, Macariini, and Cassymini occur in all four areas; six tribes (Hypochrosini, Eutoeini, Scardamiini, Abraxini, Plutodini, and Lithinini) are common to the three Old World areas, with Abraxini also being present in the Nearctic and Palaearctic Regions, and Lithinini in the Nearctic. Indeed, with the exception of Diptychini in the Afrotropical Region and Nephodiini (which may fall within the concept of Ourapterygini), surprisingly no endemic tribes have evolved in any of the regions, despite their sometimes longstanding geographical isolation, as in the case of Australia.

The fossil record for the Geometroidea dates back to the early Cenozoic only, making vicariance an unlikely explanation for the wide distribution of many tribes in the southern hemisphere, given that the Gondwanan landmasses were well separated by the late Cretaceous. Conversely, with some notable exceptions, Geometridae have limited powers of dispersal. Dispersal alone therefore remains equally unsatisfactory at present to account for the distributions described.

Southern Africa is tentatively identified as the centre of origin of Geometridae as a whole based on the presence of the endemic, relictual cycad-feeding tribe Diptychini, which is likely to be of Mesozoic origin. Diptychines are the putative sister-group to Nacophorini, which have speciated extensively in Australia, probably prior to the arrival of more modern groups, but are represented in the Nearctic and Neotropical Regions as well. Larvae of Diptychini possess a full complement of prolegs and walk in the normal lepidopteran fashion. In the temperate Archiearinae, usually considered the most primitive subfamily, prolegs are also normally developed, but the larvae progress in a looping manner.

The Place of the Australian Nacophorini in the Geometridae

Catherine J. Young

Young, C. J. (2003): The Place of the Australian Nacophorini in the Geometridae. – Spixiana **26/3**: 199-200

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The Australian Geometridae include approximately 1300 described species in 275 genera. The largest subfamily is the Ennominae with about 480 described species placed in 114 genera. Southern Australia is rich in endemic species and a large group of the Ennominae from this region have been assigned to the Nacophorini, a tribe with strong representation in southern South America.

Several groups of Australian geometrids have reportedly Gondwanan origins. The Australian nacophorines are considered to have 'primitive' characteristics such as stout hairy bodies, generalized male genitalia and larvae with a full complement of prolegs. They are well-adapted to the characteristic Australian flora and may be closely related to South American and African taxa. The Nacophorini have been proposed as a candidate for a primitive group within the Geometridae. Tasmania is the global centre of diversity of the Archiearinae, the putatively basal geometrid sub-family, with seven species. These geometrids inhabit alpine areas, are conifer-feeders and may be related to similar South American species. Australia also has the richest diversity in another geometrid sub-family, the robust-bodied Oenochrominae, which probably co-evolved with plants belonging to the Gondwanan families Proteaceae and Myrtaceae. Australia also has a large number of endemic species placed into the tribe Nacophorini.

In this study, taxonomic, systematic and ecological aspects of approximately 100 nacophorine and related ennomine species were studied. The preliminary results from a molecular study using the nuclear gene fragments 28SD2 and EF-1a were presented in this seminar. The main aims of this analysis were as follows:

1) To clarify relationships between the Nacophorini and the rest of the Geometridae.
2) To elucidate evolutionary relationships between the major sub-families and other groups of the Geometridae.

73 genera were represented in the 28S D2 analysis. Outgroup species were 3 noctuids and 2 drepanid species were included as the Drepanidae is a possible sister group to the Geometridae. The ingroup consisted of taxa from the following ennomine tribes: 22 nacophorines, 9 boarmiines, 2 lithinines, 1 azeline, 1 colotoine, 2 caberines 1 ennomine, 2 macariines. 8 archiearine species (3 genera), 2 oenochromines s.str., 2 oenochromines s.l., 5 geometrines (including 3 of the 'grey-bodied geometrines), 2 sterrhines and 5 larentiines were also included as representatives of other major sub-families. The result of a combined 28S D2 and EF-1a using a smaller sub-set of the species listed above (17 taxa) was also presented.

The main results of these analyses are presented as phylogenetic hypotheses as follows:

(a) Drepanidae as sister-group to the Geometridae.
(b) Larentiinae as basal group within the Geometridae.
(c) Sterrhinae as next basal group.
(d) *Dichromodes* (Oenochrominae *sensu lato*) basal to the Ennominae plus Geometrinae.
(e) *A. parthenias* most likely in a basal position within the Ennominae.
(f) Oenochrominae *sensu stricto* and Geometrinae possible sister groups.
(g) Boarmiini probably basal to Australian Nacophorini.
(h) Australian Nacophorini and Tasmanian Archiearinae probably sister groups and are the most derived groups in the analysis. The Tasmanian Archiearinae are most probably not closely related to the Northern Hemisphere Archiearinae.
(i) Australian Nacophorini most likely not closely related to the American Nacophorini.
(j) *Alsophila* probably belongs within the Boarmiini and is mot likely not a separate sub-family.
(k) The tribe Lithinini most likely belongs within the Australian Nacophorini.
(l) These results largely support the topology of the tree obtained by Abraham et al. (2001), ex-

cept that the Ennominae are shown to be largely monophyletic (assuming *Alsophila* has been misplaced into its own sub-family) and not paraphyletic as shown by Abraham.

The smaller combined gene analysis largely supports the 28SD2 analysis in that, the Larentiinae are in a basal position within the Geometridae and the Tasmanian Archiearinae are closely related to the Australian Nacophorini. The latter group hold a derived position in the phylogeny. Similarly the Oenochrominae s.str. hold a sister group position to the Geometrinae.

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The Foodplant relationships of the Australian Geometridae

Peter B. McQuillan

McQuillan, P. B. (2003): The Foodplant relationships of the Australian Geometridae. – Spixiana **26/3:** 200

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Australian Geometridae have diversified in a unique foodplant landscape, which features unusual plant taxa and extensive monogeneric tree canopies of low nutrient status. Sclerophylly and novel plant toxins are widespread in the flora. In addition, larvae must cope with an unpredictable climate, high fire frequency and large numbers of aggressive ants. However, there are few arboreal noctuids as potential competitors, except in the Queensland wet tropics. *Eucalyptus* (Myrtaceae) dominates the tree flora over much of the continent, while *Acacia* s.l. (Mimosaceae) dominates the extensive semi-arid shrublands.

A molecular phylogeny (28S D2) of a cross section of Australian geometrid genera gives some insight into their patterns of plant use, and indicates a complex pattern of host exploitation, involving apparent diversification within clades on some host genera, as well as some instances of putative host capture by individual taxa.

Myrtaceae, of Gondwanan origin, is the most widely used foodplant family, followed by Mimosaceae. This is not surprising given their vast geographical range across the continent. It is noteworthy that most taxa which feed on *Eucalyptus* do not feed on other Myrtaceae. *Leptospermum* and other myrtaceous shrubs have a distinct geometrid fauna. Interesting associations on other hosts include *Archephanes* on primitive Winteraceae, and *Dirce*, *Acalyphes* and *Corula* on Cupressaceae. Austral Proteaceae are exploited by *Oenochroma* and its allies, while Epacridaceae supports *Poecilasthena*.

Some associations appear to be global. Australian Caberini are associated with Mimosaceae and Rhamnaceae as elsewhere, while austral Macariini occur on Mimosaceae and Sapindaceae. Polyphagy on diverse woody plants is uncommon in Australia but has arisen in a few Boarmiini and the "nacophorine" genera *Chlenias* and *Androchela*.

Some widespread plant families, such as Casuarinaceae and Chenopodiaceae, are inexplicably poor in species of Geometridae, although the unusual monophagous genus *Rhynchopsota* has been reared from *Allocasuarina*.

The re-appearance of extra prolegs in some geometrid clades associated with *Eucalyptus* may be in response to leaf mimicry in an evergreen canopy and the challenge of traction on waxy sclerophyllic leaves.

Speciation or variation between moths from Malai peninsula and Indonesia (Borneo)?

Jaan Viidalepp

Viidalepp, J. (2003): Speciation or variation between moths from Malai peninsula and Indonesia (Borneo)? – Spixiana **26/3**: 201-202

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How much do moths vary? Or, in other words, how large may be infraspecific variation in measurements? In praxis, I have used ±5 % tolerance up to now, to decide that two specimens belong to the same species. It remains, however, to be cleared up, if that is correct.

Methods and material. Measurements (see Tab. 1) are taken with ocular micrometer on dry objects (palpus, legs) or from slides (legs of moths macerated and embedded in euparal with male genitalia). Taxa are identified according to Holloway (1996), Yazaki (1996), Holloway & Sommerer (1984) and Prout (1932).

It is well known that length of male and female palpi, as well as presence or absence of male hind tibial spurs, dilation, vestiture and the length of distal projection are diagnostic when present in various groups of Lepidoptera. So in emerald geometrids, genus *Agathia* Gn. as an example (Tab. 1).

During a routine taking measurements of study objects I have seen differences between Thailand and Borneo populations. Usually, when an object is smaller or larger than another, their measurements co-variate, i.e. change proportionally. In many of the presented cases they are not proportional. *Agathia quinaria* Moore, 1867, from Borneo has shorter

Tab. 1. Measurements of wingspan, 3rd segment of palpus, and hindlegs in some *Agathia* Gn. species from Thailand and Borneo (Sabah).

Species	locality T=Thailand B=Borneo	wingspan (mm)	slide no.	palpus 3 length X (mm)	tibia/tarsus length (mm)	tibial projection (mm)	tarsus 1 length (mm)	spur pair distance (mm)	palpus 3 length C (mm)
A. laeta	T	29	6764	0.13	5/2.5	0.5/0.7	1.25	1.45	
A. laeta	B	29-31		0.16	5/2.5	0.6/0.75	1.16	1.37	
A. quinaria	T	27	6768	0.25	**4.2/2.75**	**0.37**	**1.25**	1.25	0.9-1.0
A. quinaria	B	26.5		0.25	**4/3.25**	**0.5**	**1.0**	1.2	1.05
A. largita	T	31-32		0.2	4.2/3.25	0.3	1.5	1.1	
A. arcuata	T	25-28	6766	**0.25**	**4.2/2.75**	**0.4**	1.25	**1.12**	
A. arcuata?	T	25-28	6770	**0.3**	**4/3.25**	**0.25**	1.5	**1.25**	
A. arcuata	B	26		0.25	4.2/3.75	0.4-0.5	1.25	**1.25**	
A. deliciosa	B	27		0.27	–	–	–	–	
A. rubrilineata	T	30	6767	**0.3**	**4.75/3**	**0.5**	**1.6**	**1.37**	1.1
A. rubrilineata	B	34	6989	**0.5**	**5.3/3.3**	**0.3**	**1.75**	**1.62**	
A. diplochorda	B	29-29.5		0.4-0.5	4.25/3	0.4-0.5	1.5		
A. codina	B	44		0.4	7.2/4.5	0.9	2.5	2.25	
A. obsoleta	B	36-40	6733	0.27	7/3	1.4	1.4	2.0	
A. gigantea	B	37-40		0.25	4.25/3.7	0	2.0	1.0	
A. cristifera	T	24-25	6987	0.2	**3.5/2**	**0.45**	**1.75**	**1.0**	
A. cristifera	B	23-27	6988	0.23	**4.2/2.25**	**0.62**	**1.12**	**1.25**	
A. laqueifera	T	24	6990	0.2	–	–	–	–	0.35
A. laqueifera	B	23		0.14	3.5/2	0.45-0.6	1.0	0.87	
A. tetraplochorda	T	33		0.4	5.5/3	0.6	1.25	1.5	
A. angustilimes	T	32	6765	0.2	4.1/2.5	0.4	1.25	1.25	
A. diversiformis	T	30/39		0.16	6/2.5	0.87	0.87	2.5	1.25

tibia with longer distal projection, and longer tarsus with shorter basal segment when compared to material from Thailand. In the case of *A. arcuata* Moore, 1867, the two "variants" from Thailand and moths from Borneo differ in shape of costa, longer in "no. 6770" (*A. hemithearia* Guenée, 1858?), in presence of an additional flap-like projection medially in costa and in some other minor niceties that might fall within the limits of infraspecific variation, or characterise a vicarious species.

Taking measurements is a scrupulose and time-consuming activity. Why to do it?

It is easiest to identify butterflies and moths according to color pictures in atlases, in web, etc. It works when differences between taxa are clear-cut enough. It does not work when moths are similar one to another. And this case we must go in details. The emerald genus *Agathia* is used here as an example. Within this genus, there are groups of externally similar species, examples of clinal variation or vicarious taxa. Study of genitalia is essential for correct identification of most species. To save time, the material must be sorted somehow, in advance.

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New Geometridae from the Indopacific region

Dayong Xue & Hongxiang Han

Xue, D. & H. Han (2003): New Geometridae from the Indopacific region. – Spixiana **26/3**: 202-203

Some species relationships in the genus *Metallolophia* Warren are discussed. Diagnostic characters between *Parasthena flexilinea* Warren and a potential new species from Seram and Papua New Guinea are presented.

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1. Heterospecifity of *Metallolophia ocellata* (Warren, 1897) and *M. devecisi* Herbulot, 1989.
M. devecisi is very similar to the Indian species *M. ocellata* and has been thought as conspecific. The differences of male antennae, wing markings and distribution range show that they are different species. The diagnostic characters were given to distinguish these two species: (1) The underside of these two species are similar to each other. But in *devecisi*, the postmedian fascia on forewing is rounded from costa to M_3, then continuous to Cu_2, and forms a distinct angle at its inner margin. Postmedian fascia on hindwing in *M. devecisi* is round, but that fascia on *M. ocellata* is angled. Yellow area in *devecisi* is fairly extended. (2) There are differences in genitalia. The apex of valva is slightly different. *M. ocellata* is narrower than that of *M. devecisi*. The basal lobe of *M. devecisi* is a little shorter.

2. The relationship between *Metallolophia variegata* Holloway, 1996 and *M. cineracea* Holloway, 1996.
After comparing the materials and original descriptions of both species it is concluded that these two species might be conspecific, the wing colour differences might represent different colour forms. Three main points support this result:

- Size, wing shape, wing markings of holotypes are almost the same except slight differences in colour.
- Male genitalia of both species are almost the same except for slight differences in the width of valva and saccular process, these differences are distinctly smaller than infraspecific variation in the genitalia of *M. arenaria* (Leech, 1889).
- The localities of holotypes, Sarawak: Gunung Mulu for *M. variegata* and Brunei, Telisai for *M. cineracea* are very close to each other, only 50-70 kilometers apart.

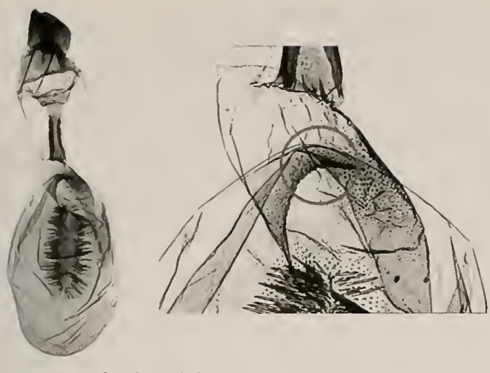

Fig. 1. *P. flexilinea* Warren.

Fig. 2. Potential new species.

3. A potential new species in the genus *Parasthena* Warren.

Specimens from Seram and Papua New Guinea were mentioned by Holloway (1997: 184) as "a related, somewhat more strongly marked, undescribed species", and the taxonomic status of this material has not been decided in the paper of Xue & Scoble (2002). Further female genitalia evidence has been found (Figs 1-2) now for separation: The potential new species shows an additional spinose crest in the posterior part of the corpus bursae, while this structure is absent in *P. flexilinea* Warren, 1902. The signum is much wider than in *P. flexilinea*. So, the material might belong to a potential new species in *Parasthena*.

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The work was carried out with the help of Dr. A. Hausmann of ZSM, Mr. M. Sommerer of Munich, Mr. G. Orhant of France, the Trustees and Staff of the BMNH, and many colleagues. It is also supported by the CAS Innovation Program.

The Identity of the Australian Archiearinae

Peter B. McQuillan

McQuillan, P. B. (2003): The Identity of the Australian Archiearinae. – Spixiana **26/3:** 203-204

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The small subfamily Archiearinae is putatively basal in the Geometridae and amphipolar in distribution. The Australian members comprise 5 described and 2 undescribed diurnal species in two genera (*Acalyphes* Turner and *Dirce* Prout) restricted to the mountains of Tasmania. They have been allocated to the Archiearinae (sensu Fletcher 1953) on morphological criteria, but features such as their general hairiness, melanized cuticle, bright colours and rapid flight may be homoplasious.

New molecular evidence (28S D2) from a cross-section of ennomine genera and including *Archiearis* Hübner, identifies *Acalyphes* and *Dirce* as a clade embedded in the Australian generalised Ennominae, and the sister group to a cluster of southern Australian genera, including *Mnesampela* Guest and *Paralaea* Guest,which have a full complement of prolegs in the larvae. *Acalyphes* larvae have extra prolegs on A3 to A5, as do their sister clade. However, extra prolegs are missing in the larvae of *Dirce*. Both *Acalyphes* and two species of *Dirce* feed on primitive endemic conifers, whereas *D. solaris* and *D. lunaris* are associated with Epacridaceae and Myrtaceae respectively. *Archiearis* is placed well outside most of the Australian ennomine genera analysed in a wider study.

On this evidence we conclude that the Australian "Archiearinae" are derived from an endemic Australian ennomine group, and that feeding on conifers is a derived rather than ancestral trait. Australian Myrtaceae are rich in essential oils such as alpha-pinene and cineole, so later adoption of conifers as foodplants may not be extraordinary. Their relationship to phenotypically similar southern Andean archiearine taxa, such as *Archiearides* Fletcher and *Lachnocephala* Fletcher, remains to be critically analysed. Extra prolegs in geometrid larvae appears to be a highly labile character, at least in some Australian higher taxa.

Some results of taxonomic research on larentiine moths from the Australasian region

Olga Schmidt

Schmidt, O. (2003): Some results of taxonomic research on larentiine moths (Lepidoptera: Geometridae) from the Australasian region. – Spixiana **26/3:** 204

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The Larentiinae are very diverse in the Australasian region. In Australia, the subfamily comprises about 280 described species in 46 genera. Larentiine moths are found in a variety of habitats from dry sclerophyll areas to rainforests. In Australia they are particularly diverse in the south-eastern tablelands and mountains, including Tasmania.

The main part of my research interest focuses on understanding phylogenetic relationships within larentiine geometrid moths at a higher taxonomic level. Current classifications of the subfamily are mostly based on taxa from the Holarctic region but a wider geographical approach is required. Taxonomic revisions of groups from other zoogeographical regions will provide the basis for creating a natural classification. In this respect taxonomic studies of genera from the Australasian region are important. In Australia, I reviewed the genera *Anachloris* Meyrick, *Chaetolopha* Warren, *Parachaetolopha* Schmidt, and *Scotocyma* Turner, as detailed below.

The Australasian genus *Anachloris* now includes three species. Their larvae feed on several species of *Hibbertia* (Dilleniaceae). Colour dimorphism was observed in later larval instars. Study of external characters and genitalia, as well as male genitalia musculature, revealed that the genus *Anachloris* does not belong to the tribe Hydriomenini in which it is currently placed. Six Australian species were assigned to the genus *Chaetolopha*, while for eight Papuan high altitude species a new genus, *Parachaetolopha*, was erected. A phylogenetic analysis yielded strong support for the separation of *Parachaetolopha* from *Chaetolopha* and the monophyly of *Parachaetolopha* is supported by ten synapomorphies. The Australasian genus *Scotocyma* is diverse in tropical and subtropical regions. Larvae of the type species, *S. albinotata*, feed on *Coprosma repens* (Rubiaceae). The tribal position of the genus is investigated. Several morphological characters support its placement in the tribe Xanthorhoini.

Work on the Eupitheciini of East and South Asia, with particular reference to the *Eupithecia* of China

Anthony C. Galsworthy

Galsworthy, A. C. (2003): Work on the Eupitheciini of East and South Asia, with particular reference to the *Eupithecia* of China. – Spixiana 26/3: 205

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Quite a lot of work has been done on *Eupithecia* in Asia. Professor Hiroshi Inoue has surveyed comprehensively Japan and Taiwan, and Nepal. V. Mironov and J. Viidalepp have done the same on Russia. J. Holloway has covered Borneo. But China remains a huge black hole in middle of this universe, and contains a great diversity of habitat, from boreal forest through desert to high mountain, subtropical and even tropical lowland.

When Dr Xue Dayong produced his book on the Larentiines of China, *Eupithecia* had to be omitted because the taxonomy was still too confused. While I was serving as British ambassador to China from 1997-2002, Dr Xue kindly allowed me to sort the large collection of *Eupithecia* which had been built up from 1949 onwards. By 2002 I had sorted the Chinese material and grouped it into about 160 species, but very few were identified, and it was difficult to decide which were undescribed.

The problem was that the only substantial collection of Chinese *Eupithecia* in Europe is the Höne collection in Bonn. This was worked on extensively from the early 70s to the end of the 80s by a Hungarian taxonomist, Dr Vojnits, who produced about 20 papers, describing in all 215 new taxa, most at species level, with a high proportion from China.

The papers were difficult to use for identification purposes. There were almost no illustrations of adults. Descriptions were difficult to follow. Drawings of genitalia were sometimes sketchy, and proved to be frequently inaccurate, due probably to the inadequately stained preparations from which he was working. There were also printing errors in the papers. Worse, when Dr A. Vojnits left the museum in Hungary, the type and other material was left in an unsorted state, and was for long inaccessible. This constituted a sort of brick wall in front of further studies of Chinese *Eupithecia*. However following heroic efforts by Laszlo Ronkay and colleagues in Budapest, the material worked on by Dr Vojnits has at last been more or less sorted, and returned to its parent institutions last year. I have been working on it with Dr Mironov.

This has enabled rapid progress. Of Dr Vojnits' 215 names, we have discovered so far that some 90 are synonyms of previously described species. There is more type material yet to be examined. But I think we are on way to clarifying the situation, and Dr Mironov, Dr Xue Dayong and I have agreed to publish together a revision of the *Eupithecia* of China. We should be able to precede this with a paper describing 30 or more new species which we have come across during our study.

Australia's subantarctic Tropics – a contradiction?

Martin Baehr

Baehr, M. (2003): Australia's subantarctic Tropics – a contradiction? – Spixiana **26/3**: 206

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The tropical rain forests of northeastern Australia harbour a multitude of carabid beetles that divide into a group of old, indigenous faunal elements with close relationships to the cool-adapted southern, circumantarctic ("Bassian") fauna, and a second group of warm-adapted species of oriental ("Torresian") origin which immigrated into Australia since about 10 Mio years ago (late Miocene). Recent surveys reveal that the majority of "oriental" carabids occur in the warm lowland rain forests, whereas the indigenous species almost exclusively range in the cooler montane rain forests above c. 700 m. Although the number of genera is almost the same, the number of species in the "Bassian" group is about three times as great. This disproportion probably is caused by plate tectonics and subsequently also by the effects of Ice Age, because the immigrating Torresian faunal elements were not able to colonize the uplands, where – during repeated periods of expansion and retreat of the cool montane rain forests during Ice Age – the Bassian faunal elements not only had survived, but also experienced a period of rapid evolution and speciation.

Hence, at least as the faunal boundary between the Bassian and Torresian subregions is concerned, the classical concept of well confined faunal subregions in Australia cannot be maintained, because the Australian tropical rain forest carabid fauna to a large extent is subantarctic. It is this old, indigenous element that mainly was responsible for the northern Australian rain forests to become a "Hot Spot" of evolution.

Phylogenetic significance of skeleton-muscular anatomy of the genitalia in Geometridae

Evgeny A. Beljaev

Beljaev, E. A. (2003): Phylogenetic significance of skeleton-muscular anatomy of the genitalia in Geometridae. – Spixiana **26/3**: 206-207

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Examination of the male genital musculature in Geometridae could provide important information for clarification of phylogenetic relationships at the tribe and genus group level. Genera *Petrophora, Scionomia* and *Ocoelophora* from Lithinini have strongly different structure of the genital skeleton, but their arrangement of phallic muscles is quite similar and shows clearly a synapomorphic state. A similar situation is between the genera *Angerona* and *Diaprepesilla*, which have rather different appearance and male genitalia but their genital musculature is similar. Combining characters of the genital musculature and skeleton supports the synonymy of Angeronini and Diaprepesillini well. On the other hand, the clustering of Angeronini with the *Ennomos*-like series of tribes is not supported by the characters of genitalic musculature. The shape of the genital segment, and the dorsal attachment of the adductor of the valva to the tegminal area, provide possible synapomorphies of Angeronini with the *Hypomecis*-like series of tribes. Genus *Devenilia*, which is superficially similar to Baptini members, has an arrangement of male genitalia musculature that is quite different from typical Baptini and unique for the examined Ennominae. A combination of apomorphic skeletal and muscle characters supports the erection of *Devenilia*, together with possibly related genera, to a separate tribe. Thus, involving the genitalic musculature in taxonomic and phylogenetic research results in an increase of analysed characters, and enables the discovery of apomorphies for relationships between morphologically diverse genera as well as for distinction in superficially homogeneous groups.

The species of the neotropical genus "*Trocherateina*" (Larentiinae)

Janusz Wojtusiak

Wojtusiak, J. (2003): The species of the neotropical genus "*Trocherateina*" (Larentiinae). – Spixiana **26/3:** 207-208

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The present studies were aimed to examine morphological and genitalic characters of all species of *Trocherateina* to estimate their relation with the genus *Erateina* Doubleday.

According to recently published Geometrid Moths of the World catalogue edited by Malcolm J. Scoble (1999), the Neotropical genus "*Trocherateina*" (Larentiinae) consists of eight species. However, there is no published reference available, as well as no species was designated as a type species of "*Trocherateina*". In the research collection of the Natural History Museum, London, the name of the genus was marked as a manuscript name proposed by Prout to separate eight distinct species from the genus *Erateina* Doubleday where they have been originally described. Of these eight species, four were described by Druce *(buckleyi, cyris, hermaea and necysia)*, two by Schaus *(cachara* and *delecta)*, one by Walker *(specularia)* and one by Felder & Rogenhofer *(pohliata)*.

In their geographical distribution species of "*Trocherateina*" occur at lower elevations in mountains ranging from Mexico to Bolivia. One species *(delecta)* is probably endemic to Costa Rica. The only two known specimens (females) of this species were collected at the elevation of 2300 m on Mt Poas. The other three *(cachara, cyris* and *specularia)* are distributed from Mexico to Guatemala at the elevation of about 1000 m and the remaining four species occur from Venezuela to Bolivia with only *T. hermaea* reaching the elevation of 2300 m.

One of the most striking morphological structure discovered in males of all species, except of *T. buckleyi* Druce, is a peculiar scent organ situated in a concave fold made by the wing membrane near the basal part of CuA vein on the dorsal side of forewings. Only very narrow slit visible between the edge of the fold and the wing membrane marks the way inside the organ. When the walls of the fold are pushed open, very small finger like scales projecting inwards are revealed. They probably serve as a containers for storage of a male pheromone. In addition a bunch of a very long, heavily sclerotized hair like scales originating from the basal part of the vein R are hidden under the fold. They may serve as a surface for the evaporation of a male pheromone when released from beneath the fold in the presence of a female.

The wings are triangular in shape, slightly narrower in males than in females with black or dark brown background and large iridescent white, semitransparent spots covering central parts of both wings. By the contrast to black scales that are of typical shape and make ground colour of the wing, scales that cover white areas are strongly bent upwards. No areole is present on forewings.

In male genitalia valvae are elongated, trapezoidal or rounded with a pronounced, hardly sclerotized thorn-like processes located at their ventral part. In *T. pohliata* and *T. cachara* those processes are asymetrical in both, the shape and length and occur on the ventral margin of the valvae. The asymetry between the left and right valvae is also marked by differently sculptured surfaces. Uncus is beak like, curved ventrally, and sharply ended. Vesica lacks spines and thorns.

In female genitalia bursa copulatrix with very large signum that is forming an irregular, heavily sclerotized and twisted cuticular plate. The shape of signum and the shape of strongly sclerotized antrum is species specific.

Notes to the molecular phylogeny of the Geometridae

Evgeny A. Beljaev

Beljaev, E. A. (2003): Notes to the molecular phylogeny of the Geometridae. – Spixiana **26/3:** 208

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Recent pilot research of the phylogeny of geometrids, base on analysis of gene fragments sequence data (Abraham et al. 2001), has revealed discouraging disharmony of molecular phylogeny of the family, compared with that, based on morphological characters. Same disharmony is tracked for other families in Lepidoptera. These results strongly actualize question on interrelationships of morphological and molecular evolution, and induce a need of functional explanation of contradictions between morphological and molecular cladograms. The morphological method of the phylogeny reconstruction allows to interpret the biological meaning of results of the investigation. The explanation is based on understanding of mechanical function, ecological or ethological significance of the morphological characters are involved into analysis. The interpretation is needed for clarification of the causes and trends of morphological transformation and separation of characters keeping the genealogical information. As to molecular phylogeny, at present, for most genes we do not know the means of transformation of gene information into physiological, morphological and ethological characters. It occludes comprehension the biological meaning of differences between results of molecular and morphological phylogenetic investigations. Both methods of phylogeny reconstruction, morphological and molecular, need to be developed parallel to each other and in close interrelation between them.

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